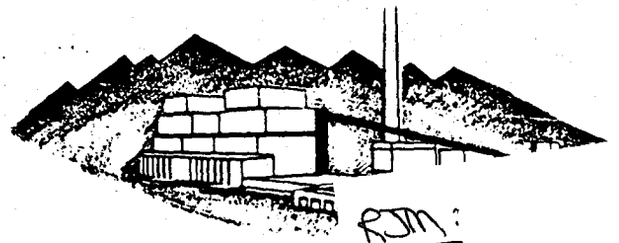


INTERMOUNTAIN POWE

CONFIRMATION: (801) 86

FACSIMILE: (801) 864

RJM:
-We want consultants coming to us (more control)

vs

RJM thru B&W

B&W stating here is our design based upon RJMs recommendations
- Lose control

FAC

DATE: 6/7/91

TO: COMPANY NAME:

ATTENTION :

FACSIMILE # :

FROM: Aeon Nissen

DEPT: Engr Services

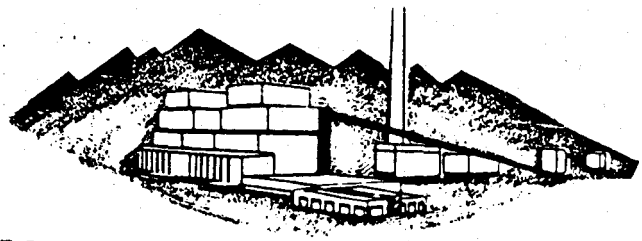
PAGES TO FOLLOW: ~~19~~ 16

COMMENTS: RJM Corp Info
Burner Evaluation Assessment

DATE & TIME SENT: 6-10-91 JR

CONFIRMATION BY:

APPROVED BY :



INTERMOUNTAIN POWER SERVICE CORPORATION

CONFIRMATION: (801) 864-4414 EXT:6577

FACSIMILE: (801) 864-4970

FACSIMILE COVER SHEET

DATE: 6/7/91

TO:

COMPANY NAME: LADWP-PDeC

ATTENTION : Raff. Kirkorian Room 604 (481-4673)

FACSIMILE # : (213) 580-0778

FROM: Fran Nissen EXT: 6482

DEPT: Engr Services

PAGES TO FOLLOW: 14 16

COMMENTS: RJM Corp Info
Burner Evaluation Assessment

DATE & TIME SENT: 6-10-91 JR

CONFIRMATION BY:

APPROVED BY :

Raffi

6/7/91

Enclosed is some literature & detail on RJM Corp. their assessment of IGS's burners.

I have sent a fax to RJM Corp with your address (phone #) for you to recieve a copy of the evaluation in parallel with IPSC's on IGS's Burner Assessment.

Address + Phone #

RJM Corporation
Richard Monroe
Ten Roberts Lane
Ridgefield, CT 06877
(203) 438-6198
FAX (203) ~~438~~ 431-8255

References: (more info will be coming next week in proposal)

1) Public Service of Oklahoma - Vic Nichols (918) 599-2546
B&W Boiler NE Unit #2
(B&W involvement)

2) So Cal Edison Peter Wanders
B&W Boiler Mandilea Stetrain
B&W is having RJM conduct modeling study

3) LA DWP contact?
Haynes Stastrom

4) We gave him copies of B&Ws proposed burner design

If you have any additional questions, please contact me (801) 864-4414 ext 6482

Adam

Burner Design Modifications

Changes to proposed BHW design:

1) Outer Air Register 2-point position settings - Cancel requirement
   - RJM Corp. has ~~stopped this until cause~~ stated this won't resolve our overheat problems.
   - Burner balancing should be done by testing (or modeling) and permanently restricting air flow to each individual burner. (They have the testing means to accomplish this)
   - Resolving air flow problems and register set-up problems should eliminate the majority of the overheat problems.

2) "TANKING-UP" Existing Burner Design - Based upon aerodynamic modeling and finite element analysis, we should be able to:
   a) minimize use of Hastelloy 800 materials (which is extremely expensive and should cut overall costs)
   b) new spin vane concept / arrangement - utilizing RJM's swirler technology

3) Recommendation on Outer Register Rear Plate -
   Possibly an insulated or perforated design to eliminate overheat conditions.

Based upon the integration of these design concepts. We should:

1) Retain or improve existing operating conditions on the boiler & burners (same amount cooling air & maintain ability to make steam temps)

2) Use of NOx technology which is RJM's prime service
   - reduce NOx (or at very least, keep the same)
     - improve scanner operation by improved flame profile
     - Improve (reduce) LOI #'s by eliminating bad acting burners
     - possibility of lowering overall excess air levels

3) Burners should last life of plant. No future overheat concerns. Reduces future maintenance requirements and possible future replacement.

If we can integrate RJM's recommendations into B&W's burner design, we think we can resolve almost all burner problems.

Their recommendations on burner design are qualitatively based and backed up ~~by~~ by sound engineering principles. Unless B&W can provide evidence to the contrary, their recommendations should be incorporated into the burner design.

BURNERS
COST ESTIMATES: Testing & Modeling

Design Evaluation:

1) Burner design evaluation — $27 000
   - design specs
   - finite element analysis
   -

2) Coal Flame Stabilizer — $ 7200
   - engineering

3) 2-D Aerodynamic Burner Flow Modeling — $ 9000

$43,200

⟹ Total for initial design review — $43,200
(10-12 weeks - turnaround for modeling results)

Options on Combustion Testing/Modeling

4) Scale Model - Air flow Evaluation — $93,000
(if want to conduct physical model air flow evaluation)

5) 3-D fluid dynamic modeling (mathematical) — $76,000
(computer based)

[Items #4-5 could be done prior to installation]

⟹ 6) Actual Test Evaluation of Burners — $34 300
(in-place test of air flow thru burners as opposed to physical model (#4) or mathematical model (#5)
requires 1 to 2 days to conduct

(Also do it on New burners after installation)

7) Air Distribution Balancing $ 40,000

requires physical test and adjustments / retest (unit must be off-line - after burner replacement outage) 5-7 day addition to Outage

[- possible to cut down with multiple test probes]

RJM CORPORATION SERVICES

- **Burner-Windbox Air Distribution Analysis** - A proprietary technique utilizing an electronic velocity probe through the burner to measure burner airflow distribution and perimeter loading by means of actual field data. The average, minimum and maximum velocities at 24 points around each burner are recorded. This data is analyzed by software developed specifically to plot individual burner profiles as well as windbox velocity potential profiles in three-dimensional format. These graphs provide the basis for RJM's engineers to make recommendations for airflow improvements. In many cases this technique has eliminated the need to build a model.

- **Oil Sprayer Plate Optimization** - Utilizing Laser Doppler techniques, the existing oil atomizer spray characteristics are documented. Based upon the results and known engineering principles for acceptable performance a new design is provided. RJM has been successful in lowering O_2 and reducing both NO_X and particulate emissions utilizing this technique.

- **Computer Program Swirler Design** - RJM Corporation uses a highly specialized, software program to determine the optimum swirler design. This program is an axisymmetric aerodynamic program originally used in the design of turbine blades. The program takes into consideration air register design, swirler loading, air register swirl, throat geometry and the required swirl number to achieve good flame stability and combustion efficiency.

- **Gas Fuel Injection Design** - Utilizing fuel rich/lean and staged combustion principles, RJM Corporation employs a computer program to design fuel-injection modifications to improve combustion performance and lower NO_X emissions. The program considers fuel trajectory, register swirl factor, fuel dispersion and flammability limits.

- **Combustion Assessment and NO_X Reduction Diagnostic Services** - Comprehensive testing diagnoses the current state of the unit's operation and provides a factual basis for predicting the effectiveness of the many NO_X reduction and combustion improvement techniques which might be applied to the unit. The diagnostic tests are definitive and include the following:

(excluding NOx evaluation)

  - Flue-Gas Chemistry Profiles Including NO_X, O_2, CO and NH_3
  - Furnace Temperature Profiling
  - Windbox/Burner Air Distribution Analysis
  - Fuels Chemistry
  - Burner Fuel Balance Deviation Profiles
  - Burner Combustion Dynamics such as burner swirl factor, fuel/air ratio profiles, flame envelope recirculation levels, localized fuel/air injection rates, etc.
  - NOxOUT® Chemical Reaction Kinetic Computer Modeling
  - NOxOUT® Injector Fluid Dynamics Computer Modeling

Developed from the diagnostic test data, a Corrective Action Program progressively recommends proven solutions in order of cost effectiveness. For each recommendation the capital and operating costs are defined and correlated against the expected NO_X reduction. The pros and cons of each technique are explained. Operational procedures, combustion hardware modifications or upgrades and/or post-combustion technologies are clearly presented so that cost effective and technologically sound management decisions can be made.

- **Low NO_X Burners and NO_X Reduction Technologies**

If additional NO_X reduction or combustion improvements are required, RJM Corporation has extensive experience in the design of low-NO_X burners and has jointly participated in low-NO_X burner development with OEMs. RJM Corporation is also a licensed implementor of the SNCR Nalco/Fuel Tech NOxOUT® process which a is proven technology for the reduction of NO_X emissions from utility boilers.

RJM CORPORATION
FEES, TERMS, AND CONDITIONS

Manpower Rate

Manpower rates are charged on an hourly portal to portal basis. RJM Corporation charges manpower at the following rates:

Engineering Services - $100/hr

Minimum Daily Charges

Minimum daily charges of personnel assigned to the field are 8 hours per day per person at the applicable manpower rate. Except for weekend travel time the minimum daily charges do not apply to travel days. Travel day charges are based on hours actually spent. Weekend travel days are charged on a minimum-daily-charge basis.

Expenses

Per-diem charges per person are $100 per day or $50 above the cost of hotel accommodations, whichever is higher. Automobile travel expenses are charged at 35 cents per mile plus all tolls. All other travel costs such as air fares, car rental, taxis, parking, etc., are charged at cost.

Field Delay Time

All delays in field projects are charged at the minimum daily rate plus per diem and applicable travel expenses. When RJM Corporation is directly responsible for the delay, such as due to failure of RJM test equipment, no delay time or minimum rates will be charged. Delays caused by any conditions beyond our direct control, such as partial or complete process shutdowns or irregularities, strikes, floods, fires, inclement weather, or failure of the client to meet hereinafter stated responsibilities, will be billed at standard rates.

Research and Development Projects

Research and development programs are by nature subject to frequent changes in scope, direction, and budgeting requirements. RJM Corporation undertakes such programs on a time-and-materials basis only. For each research and development program, a best-estimate budget is presented. Charges against this budget will be made only for time spent and costs incurred. Should a program require funding in excess of the budget estimate, the client will be notified for written approval of the new budget prior to initiating any work which would incur charges above the old budget maximum.

Combustion Optimization Programs

The performance requirements of combustion optimization programs necessitates that RJM Corporation charge such programs on a time-and-materials basis. However, for each program a budget estimate will be presented to the client. Should a program require funding in excess of the budget estimate, the client will be notified for written approval of the new budget prior to initiating the new budget.

Patents and Proprietary Technology

Companies which substantially sponsor development efforts may negotiate restricted royalty-free rights to use such devices, concepts, processes or products within their company operations and/or participation in future royalty streams. RJM Corporation reserves all rights in and to all devices, concepts, processes, products or other patentable or proprietary technology conceived or developed by RJM Corporation or its employees.

Authorizations

1. A purchase order, or a written agreement of the client's commitment, for the quoted amount must be received prior to the rendering of any services. An advance payment of 20% of the quoted amount must be made prior to the start of any field services. This amount will be applied against the final invoice amount. A purchase order issued with a "not to exceed" amount will result in the termination of field services at a point that will allow personnel to return to the base facility before the imposed limit is exceeded. Issuance of a new purchase order, written verification of addition to the existing purchase order, or documentation by authorized personnel will be needed for the continued rendering of field services.

RJM CORPORATION
FEES, TERMS, AND CONDITIONS

2. Quotations will remain valid for acceptance for a period of 30 days from date of issuance. The amount of the price quote is subject to change along with changes in project scope. All quotations are subject to conditions listed under Field Delay Time.

3. RJM Corporation represents that its procedures are generally accepted practices and methods. Tests are performed on a best efforts basis, and RJM Corporation assumes no accountability for deviations required by existing conditions beyond its direct control or field of responsibility. No guarantee or warrantee is issued, implied or intended; no responsibility is assumed for results of testing other than the accuracy of those results. Any controversies arising cannot be utilized as a reason for withholding payment. Should RJM Corporation agree that its testing was in some way materially defective, maximum liability is to repeat said test run at no additional cost. If said test run was defective because of a failure of client to supply critical information or to fulfill responsibilities, this liability does not apply.

4. RJM Corporation assumes no liability in connection with its services.

5. Unless otherwise noted, fixed prices for test work do not include pretest or post-test conferences or consulting services follow-up. Standard rates for such services will apply unless such extra efforts are at RJM Corporation's choice.

6. Any modifications or additions to the aforementioned conditions shall be made in written form.

7. This document contains the entire agreement between the parties involved, and as of the effective date hereof, supercedes all other agreements between the parties.

8. This agreement shall be governed by the laws of the State of Connecticut, to the exclusion of the law of any other forum, without regard to the jurisdiction in which any action or special proceeding shall be instituted.

Payments

Invoiced payments are due in full within 20 (twenty) days of the date of invoice.

Long-Term Projects

Once each project year all projects are subject to have their budget estimate escalated on a prorated basis in accordance with any new manpower rates or expense schedules which may be issued in that project year.

RJM CORPORATION REFERENCES

RJM Corporation has been in business since 1977 and since that time has been instrumental in providing the utility industry with superior testing procedures, designs, and modifications to improve and/or correct the operational problems associated with boilers and plant operations.

RJM Corporation has designed several systems to provide improvements for the utility industry. RJM Corporation applied for two patents which have been awarded based on these designs.

The following list of references will reflect the variety of clients RJM Corporation has worked for. With due respect to those on this list, please do not call these individuals unless you are serious about working with us at your facility.

1. **United American Energy** - Mr. Ed Tomao 201-307-1818. Formerly of Northeast Utilities where we were a substantial help in overall boiler problem solving.

2. **Central Hudson Gas & Electric** - Mr. Carl Meyer V.P. 914-486-5350 and Mr. Ron Roberts 914-486-5305. We have been consultants to Central Hudson for quite some time and Mr. Meyer is aware of our specific qualifications.

3. **Blackstone Valley Electric** - Mr. Bill Bisson, President 401-333-1400. We have been instrumental in solving serious problems at this facility.

4. **BP Oil of America** - Mr. Jim McCabe 216-586-3379 and Mr. Dave Whitmer 216-586-5531. We are currently working on several projects to improve the efficiency of several ship boilers.

5. **New England Power** - Mr. Ray Kenison 617-366-9011. A previous client who used our overall services to solve serious combustion problems.

6. **Public Service of Oklahoma** - Mr. Vic Nichols 918-599-2546. Public Service of Oklahoma hired us to solve a carbon black problem. Mr. Nichols has worked with us for approximately five months and work continues on various concerns.

Matson Navigation - Mr. Bill McDermott and Mr. Chris [illegible]rts 213-519-6546. Corrected poor flame combustion [illegible]wer O_2 and opacity.

8. **Wallingford Electric Division** - Mr. Mike Holmes 203-265-1593. Currently working on monthly projects of various natures to improve boiler operations.

9. **Consolidated Edison** - Mr. Steve Damiani 212-606-2711. Performed our Air Distribution Analysis on Consolidated Edison's tangentially fired unit to correct flame impingement and combustion concerns.

10. **Atlantic Electric** - Mr. Gary McFadden 609-645-4189. Performed Air Distribution Analysis, throat sizing modification and model specifications with project management responsibility.

11. **Nebraska Public Service** - Mr. John Cizek 308-386-2441. Performed Air Distribution Analysis to solve air distribution imbalances. Made formal report with recommendations.

12. **Dayton Power and Light** - Ms. Darina Kafka 513-549-2641 x. 5831 Performed on-site review and report to address the operational concerns of Unit No. 4 and provided estimated cost of savings with corrections in a formal report.

We hope that you find these references to be satisfactory and that we have the opportunity to work with you in the very near future.

RJM Corporation
Ten Roberts Lane
Ridgefield, CT 06877

RJM Corporation

Services, Products and Systems

TESTING SERVICES
Air distribution analysis
Coal flow analysis and balancing
Calibrated atomizer gun flow testing
Oil atomizer flow calibration
Gas flow balancing

EMISSIONS
Opacity control
LOI reduction
Acid smut fallout prevention

BOILER/AIR HEATER
On-line air heater wash system
Superheater temperature balancing
Scrubber interface for heat rate improvement
Primary air heater upgrade for corrosion control
Air heater plugging prevention

HAZARDOUS WASTE CONTROL
Process stream handling system design
Burner design
Low flash point fuels storage
Low flash point fuel pumping and piping
Processing for use as fuel

COMBUSTION
Burner upgrade – air door linkage anti-seize design
Airflow modeling
Calibrated atomizer tips
Low NO_x oil atomizer
Low particulate oil atomizer
Continuous coal flow monitor (individual burners)
High turn down flame stabilizers
Burner modification for NO_x control
Low steam consumption atomizers (.05lbs.stm/lb.oil)

CONSULTING & RESEARCH AND DEVELOPMENT

RJM's engineers are nationally recognized trouble-shooting consultants. Our specialists and staff consultants are noted for their research, development and application of new products, systems and services to improve power plant operations and control. RJM Corporation holds patents on technologies in 21 countries.

JOIN OUR LIST OF SATISFIED CLIENTS:

Utility
Atlantic Electric, Boston Edison, Central Hudson Gas & Electric Corp.,Consolidated Edison, Dayton Power & Light, El Paso Electric, Jacksonville Electric, New England Electric System, Montaup Electric Company, Niagara Mohawk Power Corporation, Northeast Utilities, Northern Indiana Public Service Company, Oklahoma Gas & Electric, Public Service of Oklahoma, Seminole Electric.

Industrial Clients
Alco Industries. Atlantic Sugar Association, Berol Corporation, Carter-Day Industries, Environmental Waste Resources, Inc., Eveready Battery Company, Gulf & Western, Solvents Recovery Service of NJ, Inc., Union Carbide.

Marine
British Petroleum, Matson Lines, Sea Land Services, SOHIO, Sun Transport.

TB073090

RELIABILITY AND PERFORMANCE SOLUTIONS

BURNER-WINDBOX AIR DISTRIBUTION ANALYSIS

RELIABILITY AND PERFORMANCE SOLUTIONS is based on demonstrated knowledge and proven experience. It is published by RJM Corporation for executives and operations personnel to provide information for improving reliability, maximizing performance, and increasing return on capital investment.

RJM Corporation • Ten Roberts Lane, Ridgefield, CT 06877 • 203-438-6198 • Fax: 203-431-8255

New Method Cuts Time and Cost of Air Distribution Analysis

Poor burner-windbox air distribution is a common problem - and a costly one, too. Now there's an innovative technology for air distribution analysis that cuts time and costs - and increases accuracy at the same time.

RJM's proprietary air distribution analysis technique eliminates the need to construct a model to simulate operating conditions. Why? Because the analysis technique uses actual data taken on your unit, rather than information drawn from simulated conditions. Real data greatly improves prospects for complete problem solving.

The investigation and response cycle of less than one week means quicker fixes and faster returns to optimum operation. If immediate corrective action or faster response is required, preliminary data analysis can be performed in the field.

Accurate Identification of Operational Problems

Use this RJM technology to correct classic burner-windbox airflow problems such as:

- **O_2 imbalances**
- **furnace gas flow imbalance**
- **high excess air levels**
- **high fly ash carbon levels**
- **high CO readings at normal excess air levels**
- **slagging "eyebrows" on burners**
- **chronic problems with flame impingement on tubes**

Also employ RJM's method of analysis to monitor furnace performance. For example, it's an inexpensive way to determine airflow balance when combustion units are being optimized for SO_x and NO_x control.

How the Analysis Works

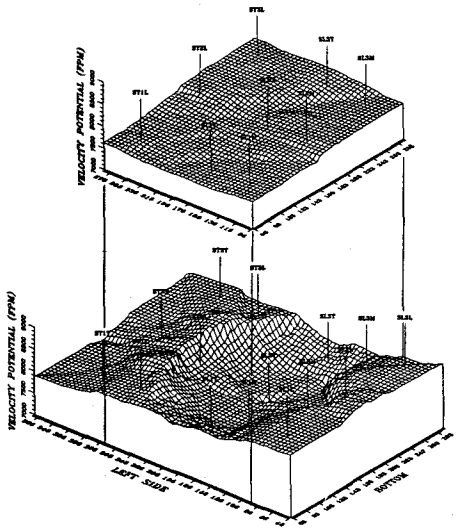
The RJM analysis technique uses a temperature compensated velocity probe inserted through a port on the burner-axis to measure burner-perimeter velocity loadings. On dual fuel or oil-fired units, access is through the oil atomizer jacket tube. RJM's method can be used on virtually all combustion units; the only requirement is that the axis of each burner be accessible to the probe through a scanner port, an oil atomizer jacket tube, or a sight port.

Report Documentation

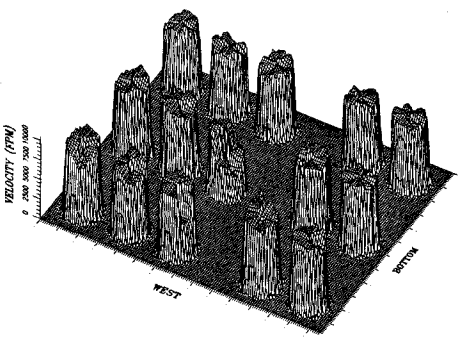
After the field testing, RJM will provide recommended solutions for combustion problems, as well as full documentation, including:

- **three dimensional projections for each burner**
- **a composite three dimensional projection for all burners**
- **windbox velocity potential profiles**
- **calculated burner deviations from required airflow**
- **individual burner perimeter loading deviations**
- **tabulated data flagged for easy evaluation**

Graphics Make the Problems Visible



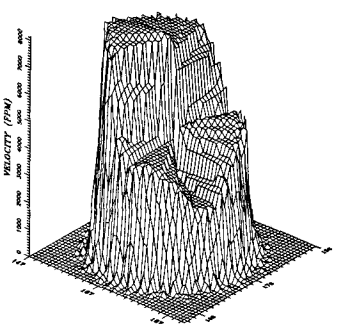
WINDBOX WITH SEVERE CYCLONIC AIR FLOW CONDITIONS
(TOP – Velocity Potential After Corrective Action)



FRONT BURNERS IN 30 BURNER OPPOSED FIRED UNIT

WHAT SHOULD YOU DO?

Call us. We are always happy to discuss your project. Ask us for our references – we are proud of our capabilities and expertise, and we will gladly send you a list of clients who have benefitted from this and many of our other unique combustion services. Finally, try us.



BURNER WITH CRITICAL PERIMETER LOADING PROBLEMS

Call us at (203) 438 6198

RJM Corporation
Ten Roberts Lane
Ridgefield CT 06877
Or call (203) 438-6198

REQUEST FOR ADDITIONAL INFORMATION

YES Please have a technical consultant call me:

Station and Unit Name _____ I can be reached at: (____) _____

The best time to call is: _____ am pm

I am interested to learn more about the following RJM Services:

- ☐ Air Flow Balancing
- ☐ Low NO_x Oil Atomizer
- ☐ Oil Atomizer Optimization
- ☐ Fuel Balancing
- ☐ Coal Flame Stabilizers
- ☐ On-Site Diagnostic
- ☐ Single zone to two zone burner conversion

Description of Problem:

_____

_____

NAME: (If not on mailing label) _____

(Please remove mailing label and place here; make necessary address corrections.)

IP7_005054